Carte Blanche

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What have I learnt?

- So much about low-mass scalar fields!
  - (Pearl, Jens, Raquel,Marco)
  - A good route to a better understanding of wave-particle duality
- Fuzzy dark matter probably doesn’t cut it
  - Over-heats disc galaxies (Jens)
  - Doesn’t always provide enough power at high k
- GC γ–ray excess probably from stars (Silvia Manconi)
- A dash of strong lensing strengthens weak lensing (Natalie Hogg)
  - and a geometrical measure of H0 is nigh

JWST over-turning ΛCDM?

- JWST sees stars & gas illuminated by stars (ALMA)
- The physics behind IGM → stellar pop is
  - in principle understood
  - uncomputable
- ΛCDM makes few reliable predictions
- It’s exciting so look back to ~400 Myr after BB,
  - just enjoy the movie

Biggest takeaway?

- QCD axions properly motivated (Wilczek 1978)
  - They *should* exist (positrons, neutrinos, Higgs)
  - They *will be* found! (Fabrice Hubaut)
- The search reminds me of LIGO in 1980s
  - Senior (& v. smart) member of Princeton community said "NSF is wasting our money.."
- Dozens of colleagues laboured over decades rewarded only by small decreases in the noise
- Their heroism is inspiring
- axion detection will be an ever more heroic challenge
  - G-wave detectors knew precisely where they had to get
  - A-wave detectors don't know where the mountain top lies!

Just a thought

- Rodrigo Vicente reminded us that GW detectors measure A not $|A|^2$
- So Volume ~ sensitivity^3 not $\text{sensitivity}^{3/2}$
- Surely it's possible to do wit emag what they do with gravity?

$$\psi = |\psi| \mathrm{e}^{\mathrm{i}\phi} \quad ; \quad \nabla\phi = \mathbf{p}/\hbar$$

$$\Delta\phi = \int \mathrm{d}\mathbf{x} \cdot \nabla\phi = \frac{1}{\hbar} \int \mathrm{d}\mathbf{x} \cdot \mathbf{p}$$

Emag wave polarised along x moving along z

$$\frac{\mathrm{d}\mathbf{p}}{\mathrm{d}t} = e\mathbf{E} = -e\frac{\partial \mathbf{A}}{\partial t} \quad ; \quad \mathbf{A} = (A, 0, 0)\cos(kz - \omega t)$$

$$\Delta p_x = -eA\cos(\omega t)$$

Interferometer at $z = 0$ with arms along x and y axes

$$\begin{aligned} \Delta\phi &= -eA\left(\int_0^L \mathrm{d}x \, \cos(\omega t) + \int_L^0 \mathrm{d}x \, \cos(\omega t) \right) \\ &= -eAv\left(\int_0^{L/v} \mathrm{d}t \, \cos(\omega t) - \int_{L/v}^{2L/v} \mathrm{d}t \, \cos(\omega t) \right) \\ &= \frac{eAv}{\omega}\left(\sin(\omega T) - \left[\sin(2\Omega T) - \sin(\omega t)\right] \right) \end{aligned}$$

e.g., $\omega T = \pi/2$ then

$$\Delta\phi = \frac{2eAv}{\omega}$$

Finally

- Thank you Julien!
- Thank you SOC!
- Thank you LOC!
- I really enjoyed being here and we go away with good memories.

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